DOE–LM/GJ704–2004

Long-Term Surveillance and Maintenance Plan for Site A/Plot M, Illinois, Decommissioned Reactor

December 2004

U.S. Department of Energy

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.

U.S. Department of Energy
Office of Legacy Management

Long-Term Surveillance and Maintenance Plan

for

Site A and Plot M
Palos Forest Preserve,
Cook County, Illinois

December 2004

Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AC01–02GJ79491
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1.0 Introduction

1.1 Purpose and Scope

This Long-Term Surveillance and Maintenance Plan (LTS&MP) is a technical plan that explains how the U.S. Department of Energy Office of Legacy Management (DOE−LM) will fulfill its responsibilities as the long-term custodian of the Site A and Plot M radioactive waste disposal sites in the Palos Forest Preserve, Cook County, Illinois. The plan provides for actions necessary for the continued protection of human health and the environment, including inspections, monitoring, and stakeholder relations.

1.2 Legal and Regulatory Requirements

DOE−LM is responsible for the radioactive materials at Site A and Plot M under the authority of the Atomic Energy Act of 1954 (42 USC 2011, *et seq.*). The primary guidance governing surveillance of Site A and Plot M is DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1990), which establishes a dose limit of 100 millirem (mrem) per year. The Environmental Protection Agency (EPA) drinking water standards found at Title 40 *Code of Federal Regulations* (CFR) Part 141 do not apply because the affected water supply (picnic water wells) does not meet the definition of a public water system (Golchert 1997). However, the Illinois EPA Class I Ground Water Quality Standards (GWQS; Illinois Administrative Code Title 35, subpart 620) for tritium and strontium-90 of 20,000 picoCuries per liter [pCi/L; equivalent to 20 nanocuries/liter (nCi)] and 8 pCi/L, respectively, are useful contamination benchmarks. Neither tritium nor strontium-90 concentrations at the picnic water wells has exceeded these standards.

The Illinois Emergency Management Agency (IEMA), Division of Nuclear Safety acts as an interested but unaffiliated third party and is available for consultation on site issues to DOE−LM.

1.3 Role of the U.S. Department of Energy

DOE's Long Term Surveillance and Maintenance (LTSM) Program, predecessor to DOE−LM, has had responsibility for Site A and Plot M since 1998. The DOE−LM Program was created in December 2003 for the purpose of conducting long-term management activities for DOE sites that no longer support DOE's ongoing missions, including Site A and Plot M.

DOE−LM is responsible for the preparation, revision, and implementation of this LTS&MP. DOE−LM is also responsible for reporting the results of site inspections and monitoring, and for maintaining records pertaining to the site.

1.4 Role of Stakeholders

Stakeholders that have been involved with Site A and Plot M include the Illinois Emergency Management Agency (IEMA), U.S. EPA Region V, the Illinois EPA, the U.S. Geological Survey, the Illinois Department of Public Health (IDPH), the Illinois Department of Nuclear Safety, the Forest Preserve District of Cook County, and the general public. Any changes made in the DOE−LM program requirements as specified in this document will be made in consultation with stakeholders.

2.0 Site Background Information

2.1 Description of Site Area

2.1.1 Location and Property Ownership

Site A and Plot M are located within the Palos Forest Preserve District of Cook County, Illinois, approximately 20 miles southwest of downtown Chicago and about 3 miles east of the current site of Argonne National Laboratory, as shown on Figure 2–1 (Biang et al. 1993). The sites were leased by the federal government from the owner, the Forest Preserve District of Cook County, from 1942 until 1956.

Approximately 8.9 million people reside within 50 miles of the site; the population within a 5-mile radius is about 150,000. The only portion of the Palos Forest Preserve in the immediate area of Site A and Plot M that is developed for public recreation is the Red Gate Woods picnic area, about 1,200 feet north of Plot M (Figure 2–1) (Golchert 1997). The area is not accessible by vehicle; however, there are several trails used for hiking, cross-country skiing, and horseback riding. These trails provide public access to Site A and Plot M (Biang et al. 1993).

Directions and mileage to the site are as follows:

Mile 0.0 - Argonne National Laboratory Main Gate (northeast side of facility, 9700 South Cass Avenue),

South on Cass Avenue until it dead ends on Bluff Avenue,

Left on Bluff Avenue,

Mile 2.0 - Right on Highway 83, Kingery Avenue,

Mile 3.0 - Across bridge and then left on Highway 171, Archer Avenue,

Mile 4.0 - Right turn at entrance road to Site A,

Mile 4.5 - Pass through locked gate and follow gravel road about 1/2 mile to Site A,

Or

Mile 4.0 - Right turn to Red Gate Woods picnic area parking lot (200 yards east of Site A entrance),

From parking lot, walk south from southeast corner of lot to find trail leading to Plot M or drive up Site A road to top of hill and take first left, then turn left again after about 100 yards.

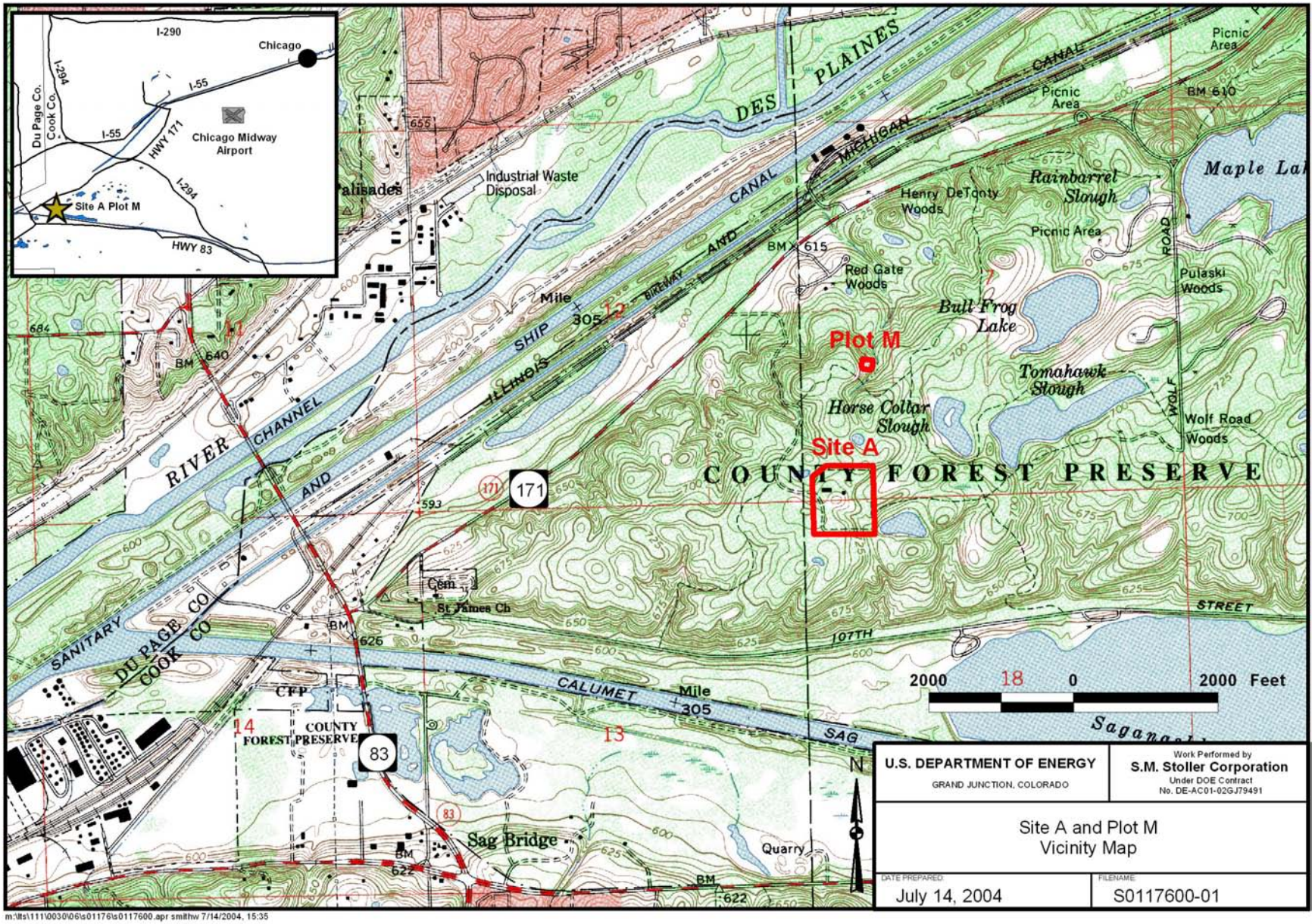

Figure 2–1. Site A and Plot M Vicinity Map

2.1.2 Topography, Geology, and Hydrology

The Site A and Plot M locations are within the 67,000-acre Palos Forest Preserve. Site A encompasses an area of 19 acres of forested, relatively flat terrain (IT 1996). Plot M, located approximately 1,600 feet north of Site A, encompasses an area of less than 1 acre.

Site A and Plot M sits on a recessional moraine upland that is dissected by two valleys, the Des Plaines River valley to the north and the Calumet Sag valley to the south. The upland is characterized by rolling terrain with poorly developed drainage. Streams are intermittent and drain internally or flow to one of the valleys. Because the soil in the upland is rather impermeable, swamps and lakes are common in the area (Biang et al. 1993). The area is underlain by glacial till or drift, dolomite, and other sedimentary rocks. The uppermost bedrock is Silurian dolomite that is about 200 feet thick The overlying glacial till has a thickness that ranges from 165 feet at Site A to zero at the Des Plaines River and Calumet Sag Canal. The depth to bedrock at Plot M is 130 feet (Golchert 1997).

Hydrologically, the surface water consists of ponds and intermittent streams. When there is sufficient water, the intermittent stream that drains Plot M flows from the highest point near Site A, past Plot M, then continues near the Red Gate Woods well (Figure 2–1) and discharges into the Illinois and Michigan Canal (Golchert 1997).

The ground water in the glacial till and dolomite forms two distinct flow systems. The shallow system consists of a fairly continuous perched water regime. The high clay content in the soils makes this possible. The flow in the glacial till is controlled principally by topography. The flow in the second system, the dolomite aquifer, which is recharged by the ground water from the glacial till, is controlled by two discharge areas, the Des Plaines River to the north and the Calumet Sag Canal to the south (Golchert 1997).

The dolomite bedrock forms an unconfined aquifer and is a major bedrock aquifer in this area. The dolomite aquifer was previously a source of drinking water (withdrawn using hand-pumped wells) in the adjacent Red Gate Woods picnic area of the forest preserve. Water is no longer available for public use because of high fecal coliform levels.

2.1.3 Climate and Vegetation

The climate is that of the upper Mississippi Valley, as moderated by Lake Michigan, and is characterized by cold winters and hot summers. Precipitation averages about 33 inches annually. The largest rainfalls occur between April and September. The average monthly temperature ranges from 21 °F in January to 73 °F in July (Golchert 1997).

The site lies within the Prairie Peninsula of the Oak-Hickory Forest Region. The Prairie Peninsula is a mosaic of oak forest, oak openings, and tall-grass prairie occurring in glaciated portions of Illinois, northwest Indiana, southern Wisconsin, and sections of other states. Much of the natural vegetation of this area has been modified by clearing and tillage. Forests in the region are somewhat limited to slopes of shallow, ill-defined ravines or low morainal ridges.

Gently rolling to flat intervening areas between ridges and ravines were predominantly occupied by prairie before their use for agriculture. The prevailing successional trend on these areas, in the absence of cultivation, is toward oak-hickory forest. Forests dominated by sugar maple, red oak,

and basswood may occupy more pronounced slopes. Poorly drained areas, stream side communities, and flood plains may support forests dominated by silver maple, elm, and cottonwood (Golchert and Kolzow 2004).

2.2 Site History

The Site A and Plot M area is the former site of Argonne National Laboratory and its predecessor, the University of Chicago Metallurgical Laboratory, which was part of the World War II Manhattan Engineer District Project, in the Palos Forest Preserve southwest of Chicago, Illinois. The Laboratory used two locations in the Palos Forest Preserve; Site A, a 19-acre area that contained experimental laboratories and nuclear reactor research facilities; and Plot M, a 150 foot by 140 foot area used for the burial of radioactive waste (Golchert 1997). These locations are shown on Figure 2–1.

Prior to the start of the Manhattan Engineer District Project, the land now occupied by Site A and Plot M was used for a golf course (Golchert, personal communication). Site A was the operational facility for two of the nation's first nuclear reactors, referred to as Chicago Pile-2 and Chicago Pile-3 (CP-2 and CP-3, respectively; DOE 1997). Besides the two reactors, an estimated 35 support buildings were also constructed at the site and included laboratory buildings, dormitories, a cafeteria, dog kennels, and a lead foundry, among others. No operations were conducted at Plot M. That site was only used for disposal of radioactive and other materials generated by Site A operations.

Operations at Site A began in 1943 and ceased in 1954. The first reactor to achieve a self-sustaining chain reaction, CP-1, was moved from the University of Chicago to Site A in 1943 and renamed CP-2. A second reactor, CP-3, was constructed on the site in 1943. Among the research programs carried out at Site A were reactor physics studies, fission product separations, tritium recovery from irradiated lithium, and studies of the metabolism of radionuclides in laboratory animals. In 1954, essentially all work was moved about 3 miles northwest to the current location of Argonne National Laboratory.

At the termination of the programs, the reactor fuel and heavy water, used for neutron moderation and reactor cooling, were removed and shipped to Oak Ridge National Laboratory. The biological shield for the CP-3 reactor, together with various pipes, valves, and building debris, were buried in place at Site A in 1956 (Golchert 1997). The CP-2 (a.k.a. CP-1) reactor shield is also buried at Site A (Biang et al. 1993). By 1956, all buildings and equipment at Site A had been decontaminated and demolished (see section 2.3 for details).

During operations, radioactive waste and radioactively contaminated laboratory articles generated from Site A research activities were buried in Plot M. Burial of radioactive waste at Plot M began in May 1944 (Biang et al. 1993); it is not clear how wastes were disposed of before that time, but it appears some may have been burned at locations at Site A (Biang et al. 1993). Disposal of wastes at Plot M was discontinued in 1949. Apparently both solid and liquid waste was buried from 1944 through 1946. Liquid wastes were disposed in intact containers, which may have subsequently been breached (Biang et al. 1993). Through 1948, waste was buried in 6-foot deep trenches and covered with soil to minimize radiation release; beginning in May 1948 burial took place in steel bins. The steel bins were removed in 1949 in a search for some missing uranium-235, which was subsequently found (Biang et al. 1993). Instead of reburying the bins, they were shipped off site for disposal; the waste buried in trenches was allowed to remain in

place. Records of items placed in Plot M are incomplete, but known items include animal carcasses, building debris, clothing, contaminated equipment, air filters, paper, and other radioactive and hazardous materials (Biang et al. 1993). Both the Site A and Plot M areas were decommissioned in 1956 (see Section 2.3).

In 1973, elevated levels of tritium were detected in two nearby hand-pumped picnic wells. The tritium was found to be migrating from the Plot M burial plot into the surrounding soil and ground water. An investigation of soils, ground water, sediment and surface water in the vicinity of Plot M was subsequently conducted which confirmed the presence of tritium in the subsurface. Tritium was also detected in surface water and sediment samples (Biang et. al. 1993). As a result, a ground water, sediment, and surface water monitoring program was instituted at the sites and continues to the present. These studies focused primarily on determining the nature and extent of near-surface radioactive contamination. During the course of studies conducted in the 1960s, a small area (30 m $\times$ 60 m) of surface soil northwest of Plot M was identified which had somewhat elevated (compared to background) concentrations of uranium and plutonium (Sedlet and Golchert 1980) and was attributed to spillage during burial and removal operations. It is not clear if these soils were removed or if they were determined to pose no unacceptable risk and left in place.

In May 1990, the Illinois Department of Nuclear Safety was conducting routine oversight monitoring at Site A when a piece of uranium metal was discovered beneath the leaves and underbrush on the forest floor (DOE 1997). Further inspection uncovered additional debris and it was eventually concluded that this area was a forgotten sanitary landfill. As a result, a number of studies were undertaken to characterize Site A. Historical knowledge was used to identify different “investigation groupings,” and “suspect areas” which were systematically sampled and analyzed for both radiological and chemical constituents. Geophysical surveys were conducted to investigate suspected burial areas and subsurface anomalies were evaluated. The investigations determined that surface soils in several areas at Site A contained radiological contamination at levels above background. A number of physical hazards were also identified (e.g., pipes protruding from the ground, concrete rubble).

A risk assessment conducted in association with these characterization efforts indicated that residual contamination at Site A posed only minimal risk. However, in consultation with various stakeholder groups, DOE determined that it was in the best interest of the general public to conduct a voluntary cleanup action. Physical hazards were removed by the U.S. Army Corps of Engineers in 1995. A limited removal action to address chemical and radioactive wastes was conducted in 1997. Subsequent verification surveys confirmed that radiological cleanup criteria had been met (see Appendix A), and control of Site A was returned to the Cook County Forest Preserve District (DOE 1997).

2.3 Stabilization/Isolation Technique

2.3.1 Decommissioning

Site A research activities ceased in May 1954, when the reactors were shut down. The CP-2 and CP-3 reactor shells were demolished and buried, and the support facilities and buildings were decontaminated and torn down (DOE 1997). Uncontaminated materials were removed from the site, and arrangements were made to return the site to the Forest Preserve District.

An excavation approximately 100 feet across and 40 feet deep was prepared between the two reactors. The reactors themselves were approximately 180 feet apart. The 800-ton, concrete-filled, shell of the CP-3 reactor was buried by excavating around it on three sides and detonating strategically placed explosives in the earthen "pedestal" supporting it. The reactor shell rolled and ended upside down in the excavation (Biang et al. 1993). The concrete shield of CP-2 was demolished and pushed into the same excavation. The buildings that housed the reactors were demolished and placed in the excavation. The excavation was then backfilled, leveled, and landscaped (Biang et al. 1993). The top of the CP-3 reactor shield is approximately 23 feet below ground surface; rubble and building debris fill the excavation both laterally and vertically to within a few feet of the surface (Bechtel 1995). A large, engraved stone marker briefly describes the history of the site and indicates the approximate burial location.

In 1956 Plot M was stabilized and isolated by backfilling after waste burial and encasing the sides and top of the burial zone with concrete. The disposal area was surrounded by concrete walls 8 feet deep and 1.5 feet thick. A 1-foot thick concrete slab was placed over the top of the entire disposal area. The walls and slab are reinforced with wire mesh (Biang et al. 1993). The concrete was covered with 2 feet of soil, seeded with grass, and an inscribed granite marker was placed in the center of Plot M (Golchert 1997). The purpose of the concrete barrier was to prevent people from digging into the waste and to impede the flow of water through the buried radioactive materials (Biang et al. 1993).

2.3.2 Voluntary Removal Action

In 1995, a physical hazard removal action was conducted by the U.S. Army Corps of Engineers. Concrete rubble from foundations of the former support buildings, various pieces of pipe that were protruding from the soil surface, manholes, and other construction rubble were removed from Site A. In addition, holes resulting from subsidence of the former sewage system were backfilled. This action was completed in the fall of 1995 (DOE 1997).

A voluntary removal action of contaminated soil and debris was completed at Site A in 1997 (DOE 1997). This removal action consisted of excavation of approximately 360 cubic yards of contaminated soil. An additional 140 cubic yards of debris, consisting primarily of graphite blocks, were also removed. The soil and debris were mixed with Portland cement and shipped to the Hanford site near Richland, Washington, for disposal. Following completion of excavation, approximately 2000 cubic yards of clean clay were spread across the excavated areas to minimize ground water percolation. Topsoil was brought in, placed over the clay, and reseeded to Forest Preserve District specifications. Additionally, three mounds of sludge from a chemical or water treatment facility (referred to as "milorganite"), previously brought to the area for use as fill and fertilizer, were leveled, covered with topsoil and also reseeded to Forest Preserve District specifications.

The Record of Decision (ROD) for Site A (DOE 1997) documents cleanup activities that were completed at Site A. The ROD also includes the radiological verification report that was completed by the Illinois Department of Nuclear Safety. It is assumed that decommissioning activities at Plot M adequately addressed any concerns over surficial contamination.

2.4 Current Site Conditions

The surface at both Site A and Plot M is considered to be clean and suitable for recreational use IDPH 2002a and 2002b). Hiking trails and bike paths are in use in the area. A picnic area is located adjacent to Plot M in the Red Gate Woods. The Cook County Forest Preserve District has control over surface use. DOE is responsible for the wastes buried at both Site A and Plot M. Consistent with the Forest Preserve's goal of "preserving nature," Forest Preserve regulations do not allow any digging. Consequently, it is assumed that this "land use restriction" remains in effect at Site A and Plot M and that buried wastes will not become exposed through intentional human intrusion (DOE 1997). The concrete cap and vegetation on Plot M will prevent exposures of buried waste there through surface erosion. Vegetation at Site A will inhibit, though does not ensure prevention of, erosion that could expose buried wastes. However, the most radioactive wastes were placed at depth and covered with largely uncontaminated building rubble and debris which in turn was covered with clean fill.

The primary constituents of concern in ground water and surface water in the vicinity of Site A and Plot M are tritium (hydrogen-3) and strontium-90. Radiological characterization of Site A and Plot M showed that very low levels of tritium migrated from the burial ground at Plot M and were observed in two nearby hand-pumped picnic wells in the Red Gate Woods area approximately 1,500 feet to the north. (Pump handles have subsequently been removed to prevent exposure to fecal coliform contamination detected in the picnic wells. The fecal coliform contamination is not related to Site A or Plot M.) Tritium activity is still detected in the picnic wells, but average and maximum activities are significantly less than previous observations and well below the Illinois Class I ground water quality standard of 20,000 pCi/L [equivalent to 20 nanoCuries per liter (nCi/L)]. Tritium concentrations continue to exceed the Illinois standard in a number of monitor wells at the sites and a surface stream in the vicinity of Plot M. Low levels of strontium-90 have been observed in ground water from several monitor wells near Site A and Plot M since 1984. The Illinois GWQS for strontium-90, 8 pCi/L, was exceeded at one location in the glacial till at Site A in 2003 (13.14 pCi/L).

Table 2–1 presents the analytical results of the ground water and surface water monitoring program for Site A and Plot M for 2003 (from Golchert 2004). Results are presented only for those locations that will continue to be monitored in the future (see Section 3.3). These locations are shown on Figure 3–1.

A detailed investigation of the hydrogeologic and geochemical properties of the glacial drift was conducted by the U.S. Geological Survey (USGS) to determine the extent of tritium in the glacial drift and the rate and direction of movement in ground water in bedrock (USGS 1984). These studies showed that anisotropic geologic and hydraulic properties of the drift significantly affected ground water flow and contaminant migration. The size, shape, and configuration indicate that the plume is a single slug and that the site no longer releases tritium into the glacial drift. The leading edge (or front) of the plume probably left the burial site in the late 1940s or early 1950s and intersected the underlying bedrock surface before 1973. Several key factors that control both the activity level and the extent of migration of tritium in ground water in the glacial drift at Plot M are: (1) the limited amount of tritiated waste buried at Plot M, (2) the long period of time that has elapsed since the waste was buried relative to the radioactive half-life of hydrogen-3 (approximately 12.3 years), and (3) the great thickness and low permeability of the

glacial drift at the site. Therefore it is anticipated that contamination in ground water at the sites will continue to decrease over time.

Table 2–1. Summary of 2003 Analytical results for Site A and Plot M COCs, Palos Forest Preserve, Illinois

Area	Number	Tritium Range in nCi/L	Strontium-90 Range in pCi/L
Illinois GWQS		20	8
Ground Water from Monitor Wells in Glacial Drift			
Plot M	BH2	5.0–3,385	<0.25
	BH3	810–1,050	<0.25
	BH4	636–719	<0.25
	BH6	58.1–60.0	0.51-1.00
	BH9[a]	457[b]	4.59[b]
	BH10[a]	62.7–270	<0.25-0.42
	BH11s	27.8–234	<0.25-2.99
	BH26	164–455	<0.25-0.65
	BH35	61.3–437	<0.25
Site A	BH41	0.1–0.3	<0.25
	BH51	<0.1	<0.25
	BH52	<0.1	<0.25
	BH54	0.1–0.2	<0.25
	BH55	6.6[b]	13.14[b]
	BH56	3.9–3.9	2.82-2.97
Ground Water from Monitor Wells in Dolomite			
Plot M	DH3	1.5–1.5	na
	DH4	0.1–0.8	na
	DH9	0.6–0.9	na
	DH10	0.6–1.7	na
	DH11	2.0–2.1	na
	DH12	0.9–2.8	na
	DH13	0.4–1.7	na
	DH14	0.7–2.3	na
	DH15	1.6–2.0	na
	DH17	0.3–0.5	na
Ground Water from Picnic Wells in Dolomite			
	5159	<0.10–1.49	na
	5160	0.65–1.78	na
Surface Water and Seep			
Plot M	0001	<0.1	na
	0006	<0.1–4.1	na
	0007	0.4–1.3	na
	0008	0.3–0.7	na
Regional	Ponds – 5[c]	<0.1	na

na = not analyzed; nCi/L = nanoCuries per liter; pCi/L = picoCuries per liter
[a]Slant hole drilled at 45^{o}
[b]Hole was dry except for one event
[c]The ponds are Horse Collar Slough, Bull Frog Lake, Tomahawk Slough, and two unnamed ponds northwest and southeast of Site A. These were sampled in December 2002.

2.5 Risk

Risks posed by the Site A and Plot M sites have been evaluated since monitoring and characterization activities were undertaken in the 1970's. The only pathways that are currently complete involve exposures to any contaminants that may be present at the surface of the sites. Ground water is not currently being used at the site. Buried wastes at the two sites have adequate cover to prevent exposure to buried wastes. The forest preserve district controls land use and will impose restrictions on drilling or excavating in the area.

Limited removal actions were implemented at Site A in 1995 and 1997. The 1995 action removed potential physical hazards at the site. The 1997 action resulted in removal of contaminated soils that exceeded background levels of some constituents. The need for these actions was not driven by risk; they were conducted as a best management practice. The Illinois Department of Nuclear Safety concurred that radiological cleanup criteria were met at Site A (see Appendix A).

As discussed in the previous section, activities of tritium and strontium-90 have been detected in well water in the vicinity of Site A and Plot M though the vast majority of samples have been well below the Illinois GWQS of 20,000 pCi/L (20 nCi/L) and 8 pCi/L, respectively (Illinois Administrative Code Title 35, subpart 620). At one time, picnic wells at the Red Gate Woods were used as a source of drinking water for visitors to the picnic grounds. These wells were removed from service due to contamination unrelated to Site A or Plot M. The only complete route of exposure to ground water is where the water surfaces at a local seep and intermittent surface stream. Because potential exposures to contaminated ground water and surface water are of low frequency and duration, it can be concluded that actual risks posed by site-related contamination are negligible to nonexistent. Potential risks continue to decrease as activities of constituents in the ground water system continue to decline. Results of the surveillance program continue to indicate that while radioactivity remains in the subsurface in the vicinity of Site A and Plot M and at the surface seep at Plot M, the potential for release of hazardous amounts of contamination into ground water and surface water is low and the observed levels of contamination do not endanger the health or safety of the public visiting the site, using the picnic area, or living in the vicinity. Potential radiation doses are well below the relevant standards.

The IDPH conducted recent public health assessments of Site A and Plot M (IDPH 2002a and 2002b). The IDPH came to the conclusion that cleanup at Site A has been adequate to protect the public from any risks that the site may have posed in the past. IDPH also concluded that under current conditions, exposures at Plot M are not at levels that would be expected to cause adverse health effects, and therefore the site does not pose a public health hazard. Based on infrequent exposures that would be likely to occur at the sites today, and the fact that contaminated materials are buried at depth, the sites were determined to currently not pose any unacceptable risks.

End of current text

3.0 Long-Term Surveillance and Maintenance Program

3.1 Stewardship Overview

DOE−LM will conduct stewardship activities at the Site A and Plot M sites to protect human health and the environment and to comply with applicable regulations. DOE−LM is responsible for the radiological and other hazardous substances that remain at Site A and Plot M. The Cook County Forest Preserve is responsible for maintenance of the land surface. IEMA and IDPH will oversee DOE−LM stewardship activities at the site.

This plan implements long-term components of remedies selected for Site A and Plot M. DOE−LM will maintain protectiveness at the sites through a combination of government ownership, conducting regular inspections, maintaining public awareness, and monitoring environmental media and institutional controls.

3.2 Inspections

3.2.1 Routine Inspections

Site inspections are guided by a checklist that addresses the performance of the inspection. The most recent completed checklist for the site is included in Appendix B. The inspection base map for the site is included on Figure 3–1. The map will graphically depict the locations of noted observations from the previous inspections and is used to record field notes, photograph locations, and other annotations of inspection findings. The field map becomes a part of the permanent site record. At the conclusion of a site inspection, inspectors will note revisions to the checklist in anticipation of the next site inspection. Revisions to the checklist may include inspection instructions addressing new observations, notes about maintenance conducted since the previous inspection, or progressive changes in site conditions.

The annual inspection will include an evaluation of both on-site and adjacent off-site erosion, should any be occurring. Special attention will be given to situations where headcutting in the direction of the disposal sites is noted. The local topography and vegetation is expected to keep erosion considerations at a minimum. However, changes in local conditions may bear evaluation.

During annual inspections the condition of site vegetation also will be assessed. Since vegetation is a primary deterrent to erosion, continued vegetation health is important.

During site inspections it may be useful to document some types of observations with photographs. Such observations may be evidence of vandalism, changed conditions, or maintenance needs. Inspectors will record photograph information on an approved photograph log, which becomes part of the LM site record maintained at the DOE−LM facility in Grand Junction, Colorado.

Typically, two inspectors will perform annual inspections. Inspectors will be experienced engineers or scientists who have the required knowledge, skills, and abilities to evaluate site conditions and recognize imminent or actual problems.

3.2.1 Follow-up Inspections

Follow-up inspections are unscheduled inspections that are conducted in response to threatening or unusual site conditions.

DOE−LM may conduct follow-up inspections if the following occurs:

- A condition is identified during the routine site inspection, or other site visit, that requires personnel with specific expertise to return to the site to evaluate the condition; or

- DOE−LM is notified by a citizen, employee, or federal, state, or local agency that conditions at the site are substantially changed.

Once a condition or concern is identified at the site, DOE−LM personnel will evaluate the information and decide whether to respond with a follow-up inspection.

Specific conditions that may necessitate a follow-up inspection include unauthorized intrusion, violation of institutional controls, vandalism, or the need to revisit the site to evaluate, define, or conduct maintenance tasks. Conditions that may require a more immediate follow-up inspection include extreme weather or seismic events and disclosure of human activity that threatens the integrity of waste containment. DOE−LM will evaluate risk when scheduling follow-up inspections. Urgency of the follow-up inspection will be in proportion to the seriousness of the condition.

In the event of an incident or activity that threatens or compromises institutional controls or poses a risk of exposure to or release of known contaminants, DOE−LM may, as appropriate, notify the IEMA, begin the DOE−LM occurrence notification process (DOE Order 232.1), respond with an immediate follow-up inspection, and begin emergency measures to contain or prevent dispersion of constituents from the Site A or Plot M sites. At any time, DOE−LM may request the assistance of local authorities to confirm the seriousness of a condition at the site before scheduling a follow-up inspection or initiating other action. Contingency plans are presented in Section 3.8.

The public may use the 24-hour numbers monitored at the DOE−LM office in Grand Junction, Colorado (970-248-6070 or 877-695-5322) to request information about the site or to notify DOE−LM of site concerns.

Inspectors assigned to follow-up inspections will be selected on the same basis as for routine site inspections (Section 3.1.1). Results of follow-up inspections will be included in the next annual inspection report (Section 3.3). Separate reports will not be prepared unless DOE−LM determines it advisable to notify IEMA or other outside agency of a situation at the site that remains uncorrected. If follow-up inspections are required for more serious or emergency reasons, DOE−LM will submit a preliminary report of the inspection within 60 days of the inspection.

3.3 Ground Water and Surface Water Monitoring

Various parameters of the Site A and Plot M environment have been monitored to varying degrees since the site was decommissioned in 1956. In the past, ground water, surface water, air, and stream sediments were systematically monitored. As part of the transfer of Site A and Plot M to DOE−LM at Grand Junction, Colorado, for long-term surveillance and maintenance, the existing monitoring program was evaluated (DOE 2003). The technical evaluation consisted of a qualitative review of Argonne National Laboratory (ANL) environmental monitoring results for the past 10 years (e.g., Golchert 1997). Initial assessment of the program indicated that monitoring had demonstrated that the sites were behaving as predicted and there was no unacceptable risk to human health and the environment.

In the context of long-term stewardship activities at other DOE−LM sites, it appeared that the monitoring program could be scaled back without compromising DOE's ability to observe areas where potential problems or exposures may exist and ensure ongoing protection of human health and the environment. Currently there are two major objectives of the monitoring: (1) ensure that existing contaminant concentrations continue to decrease as expected due to radioactive decay and other natural processes and (2) detect any potential future releases (though these are considered unlikely). The technical evaluation was developed with a group consisting of the staff and contractors representing DOE−LM, ANL, DOE Chicago Operations Office (DOE−CH), and IEMA.

Based on discussions and consensus of the group, the revised environmental monitoring program being implemented at Site A and Plot M, effective in February 2004, as follows (DOE 2004a):

- The monitoring program is defined in Table 3–1 and shown on Figure 3–1. This consists of 36 locations sampled on a quarterly basis, with 144 analyses for tritium and 60 analyses for strontium-90.
- Sampling, analysis, and reporting will be conducted by ANL personnel as in the past. The sampling crew will also make observations of the sites while performing the quarterly water sampling, which will be part of the overall surveillance for security and maintenance of the sites.
- Analytical data will be available to stakeholders. DOE−LM will maintain a database for reference and presentation to stakeholders. Reporting and distribution of information to stakeholders will be performed in the method standardized under the DOE−LM long-term surveillance and maintenance program. Information will be presented in annual reports and will be available on the DOE−LM website (www.gjo.doe.gov).

Justification for the sampling locations is based on technical and stakeholder concerns. The distribution of locations will ensure that conditions will be known to remain protective. The quarterly frequency is based on variable weather and the seasonal response in the hydrogeologic system. Also the inherent complexity of the hydrogeologic system will be more closely monitored with this frequency. Analyses are restricted to the main constituents of concern which are tritium and strontium-90. Analyses of metals are no longer needed since it has been determined that they are not related to potential source materials.

Table 3–1. Summary of Environmental Monitoring Program for Site A and Plot M, Palos Forest Preserve, Illinois

Area	Number	Frequency and Analytes	Location
Ground Water from Monitor Wells in Glacial Drift			
Plot M	BH2	4X H/S	Downgradient from Plot M
	BH3	4X H/S	Downgradient from Plot M
	BH4	4X H/S	Downgradient from Plot M
	BH6	4X H/S	Cross gradient from Plot M
	BH9	4X H/S	Slant hole beneath Plot M
	BH10	4X H/S	Slant hole beneath Plot M
	BH11s	4X H/S	Downgradient from Plot M
	BH26	4X H/S	Downgradient from Plot M
	BH35	4X H/S	Farther downgradient from Plot M
Site A	BH41	4X H/S	Onsite --downgradient to west of Site A
	BH51	4X H/S	Onsite -- south of Site A
	BH52	4X H/S	Offsite -- east of Site A
	BH54	4X H/S	Onsite -- north of Site A
	BH55	4X H/S	Onsite -- middle of Site A
	BH56	4X H/S	Onsite -- middle of Site A
Ground Water from Monitor Wells in Dolomite			
Plot M	DH3	4X H	Downgradient from Plot M
	DH4	4X H	Farther downgradient from Plot M
	DH9	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH10	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH11	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH12	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH13	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH14	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH15	4X H	Downgradient from Plot M and adjacent to picnic wells
	DH17	4X H	Downgradient from Plot M and adjacent to picnic wells
Ground Water from Picnic Wells in Dolomite			
	5159	4X H	Recently used picnic well -- may be used for drinking in future
	5160	4X H	Recently used picnic well -- may be used for drinking in future
Surface Water and Seep			
Plot M	0001	4X H	Upstream from Plot M
	0006	4X H	Seep -- adjacent to Plot M
	0007	4X H	Downstream from Plot M
	0008	4X H	Downstream from Plot M
Regional	Ponds - 5	4X H	Adjacent ponds in vicinity of Site A

Key:
4X = frequency per year at location
H = hydrogen-3 (tritium)
S = strontium-90

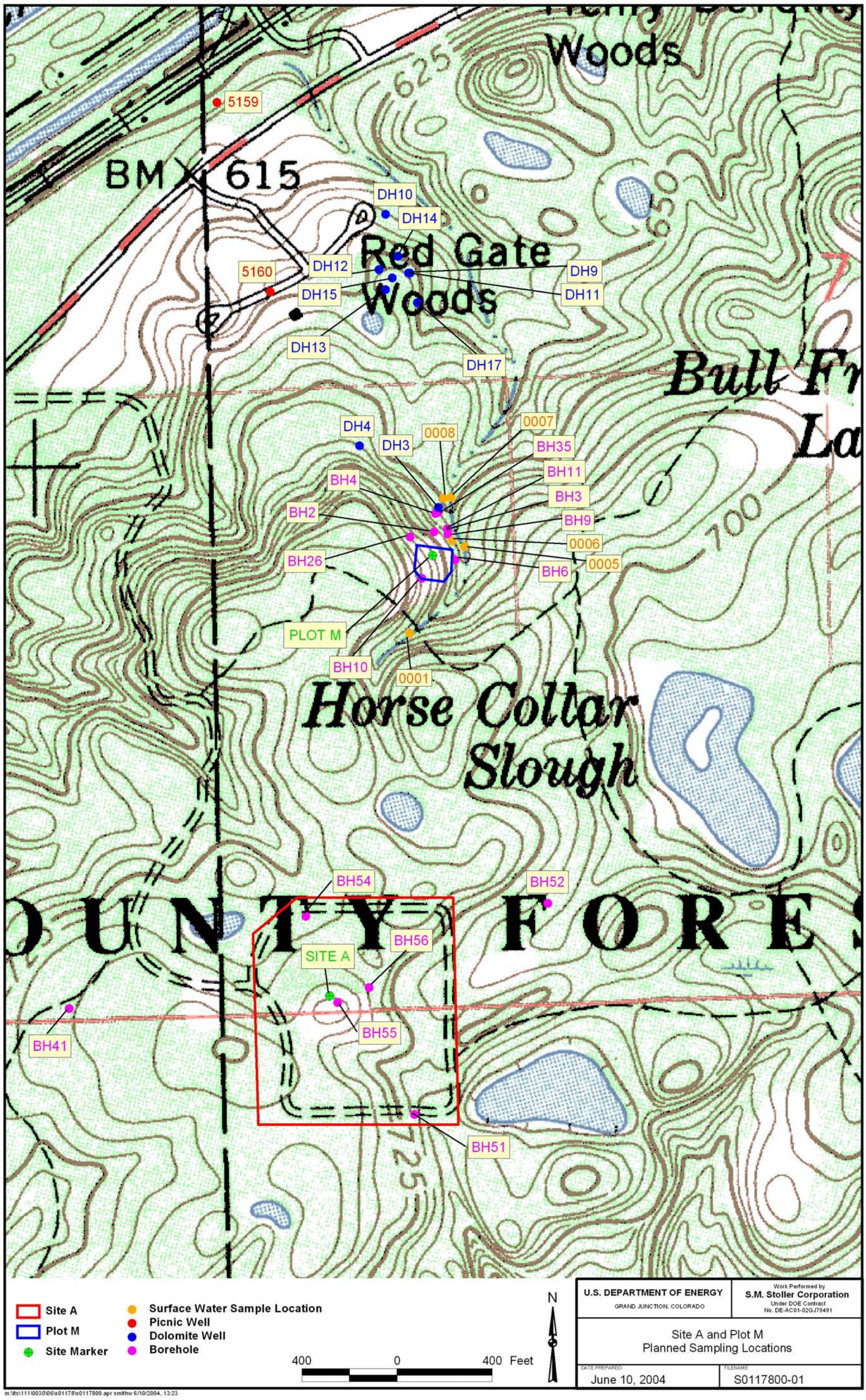

Figure 3–1. Site A and Plot M Monitoring Locations and Inspection Map

DOE−LM will evaluate this monitoring program every three to five years. Changes should be implemented in the program, as deemed necessary, and with input from the stakeholders, to maintain the DOE−LM mission of protection of human health and the environment, and to reasonably reflect conditions at the sites and the level of potential risk.

3.4 Inspection and Monitoring Reports

Inspection and monitoring results will be recorded in an annual status report. A copy of the report will be distributed to interested stakeholders and posted on the DOE−LM web site.

3.5 Maintenance, Repairs, Emergency Response, and Ground Water Corrective Action

3.5.1 Maintenance and Repairs

Maintenance refers to routine activities that may be necessary to prevent long-term site degradation or deterioration from a public perception standpoint. Anticipated tasks such as grass mowing fall into this category. The Palos Forest Preserve District, as landowner, is responsible for routine maintenance of the site surface (e.g., erosion, groundskeeping, public safety issues).

Repairs are actions taken to restore a structure to design conditions. DOE−LM will conduct repairs for the structures the Department is responsible for (e.g., wells, markers and monuments, and the Plot M waste containment system).

3.5.2 Emergency Response

DOE−LM will respond to “unusual damage or disruption” that threaten or compromise site safety, security, or integrity. DOE−LM will contain or prevent dispersal of radioactive materials in the unlikely event of an actual breach of the site containment systems.

3.5.3 Ground Water Corrective Action

Currently, ground water quality at some locations slightly exceeds standards for tritium and strontium-90. Concentrations continue to decrease and currently complete exposure pathways present no unacceptable risk. If abrupt reversals in trends or concentrations are observed, DOE−LM would first conduct confirmatory sampling. If confirmatory sampling verifies the exceedance, DOE−LM will initiate an evaluative monitoring program. Results of the evaluative monitoring program would be used to determine if corrective action is necessary.

If corrective action is necessary, DOE−LM will develop and implement a ground water corrective action plan in consultation with IEMA.

3.6 Records

DOE−LM maintains records at their office in Grand Junction, Colorado, to support post closure maintenance of the closure site. These records are being maintained by LM because they contain critical information required to protect human health and the environment, manage land and

assets, protect legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste. DOE−LM will include records generated during site operations in the LM site collection. Inactive or retired site records will be stored in a federal records center. The records are managed in accordance with the following requirements.

- Title 44, *United States Code* (U.S.C.), Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," Chapter 31, "Records Management by Federal Agencies," and Chapter 33, "Disposal of Records."
- Title 36 *Code of Federal Regulations* Chapter 12, Subchapter B, "Records Management"
- DOE G 1324.5B, "Implementation Guide"
- *LM Information and Records Management Transition Guidance*.

3.7 Quality Assurance

The long-term custody of Site A and Plot M, and all activities related to the annual surveillance and maintenance of the sites, will comply with DOE Order 414.1A, *Quality Assurance*, the DOE−LM contractor's *Long-Term Surveillance and Maintenance Program Quality Assurance Program Plan* (DOE 1999 or current), and the draft *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ASQC 1994).

3.8 Health and Safety

Health and safety requirements and procedures for DOE−LM activities are consistent with DOE Orders, federal regulations, and applicable codes and standards. The DOE−LM Integrated Safety Management process serves as the basis for the contractor's health and safety program.

Specific guidance is contained in the *Office of Land and Site Management Project Safety Plan* (DOE 2004b). This project safety plan identifies specific hazards associated with the anticipated scope of work and provides direction for the control of these hazards. During the pre-inspection briefing, personnel are required to review the plan to ensure that they have an understanding of the potential hazards and the health and safety requirements associated with the work to be performed.

4.0 References

American Society for Quality Control (ASQC) 1994. *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs,* draft, ANSI/ASQC E4-19XX, Energy and Environmental Quality Division, Environmental Issues Group, January.

Bechtel National, Inc., 1995. Characterization Report for Palos Forest Preserve, Site A, Volume 1.

Biang, R. P. et al., 1993. Environmental Review for Site A/Plot M, Palos Forest Preserve, Cook County, Illinois, ANL/EAIS/TM-99, Argonne National Laboratory, Argonne, Illinois, June.

Illinois Department of Public Health (IDPH), 2002a. *Public Health Assessment, Palos Forest Preserve—Argonne Site A, Cook County, Illinois, 107th and Archer Avenue,* December 20.

———, 2002b. *Public Health Assessment, Palos Forest Preserve—Argonne Plot M, Cook County, Illinois, 107th and Archer Avenue,* December 20.

Golchert, N.W., 2004. *Surveillance of Site A and Plot M Report for 2003,* ANL-04/1, Argonne National Laboratory, Argonne, Illinois, May.

———, 1997. *Surveillance of Site A and Plot M Report for 1996,* ANL-97/5, Argonne National Laboratory, Argonne, Illinois, May.

Golchert, N.W. and R.G. Kolzow, 2004. *Argonne National Laboratory-East Site Environmental Report for Calendar Year 2003,* ANL-04/2, Argonne National Laboratory, Argonne, Illinois, September.

Illinois Administrate Code Title 35, Subpart 620, Groundwater Quality .

IT, 1996. *Draft Final Work Plan, U. S. Department of Energy, Limited Source Removal, Site A, Palos Forest Preserve, Cook County, Illinois,* IT Corporation, September.

Sedlet, J. and Golchert, N.W., 1980. "Migration of Radionuclides Following Shallow Land Burial" in *International IRPA Congress Proceedings,* p. 99-102, March.

Title 44, *United States Code* (U.S.C.), Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," Chapter 31, "Records Management by Federal Agencies," and Chapter 33, "Disposal of Records."

Title 36 *Code of Federal Regulations* Chapter 12, Subchapter B, "Records Management."

U.S. Department of Energy (DOE), 1990. *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, February 8.

———, 1999. Record of Decision for Site A, July.

U.S. Department of Energy (DOE), 1999. *Long-Term Surveillance and Maintenance Program Quality Assurance Program Plan*, Grand Junction, Colorado.

———, 2003. *Evaluation and Recommendation for Environmental Monitoring at Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*, draft, GJO-2003-462-TAC, Grand Junction, Colorado, August.

———, 2004a. *Environmental Monitoring Program at Site A and Plot M, Palos Forest Preserve, Cook County, Illinois*, Grand Junction, Colorado, February.

———, 2004b. *Office of Land and Site Management Project Safety Plan*, Grand Junction, Colorado, June.

———, (pending). *LM Information and Records Management Transition Guidance*, Grand Junction, Colorado.

DOE Order 414.1A, *Quality Assurance*.

DOE G 1324.5B, *Implementation Guide*.

U.S. Geological Survey (USGS), 1984. *Low-Level Radioactive-Waste Burial at the Palos Forest Preserve, Illinois: Geology and Hydrology of the Glacial Drift, as Related to the Migration of Tritium*, U.S. Geological Survey Water-Supply Paper 2226.

Appendix A

Regulator Concurrence

TEC.970512.0004

STATE OF ILLINOIS
DEPARTMENT OF NUCLEAR SAFETY
1035 OUTER PARK DRIVE
SPRINGFIELD, ILLINOIS 62704
217-785-9900
217-782-6133 (TDD)

Jim Edgar
Governor

Thomas W. Ortciger
Director

May 9, 1997

Ms. Sue Nielsen
Site A Project Manager
U. S. Department of Energy
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

Dear Ms. Nielsen:

The Illinois Department of Nuclear Safety (IDNS) has completed its report on remedial actions taken by the Department of Energy at Site A of the Palos Forest Preserve. This report describes IDNS's involvement in the cleanup of the park and documents the final radiation surveys conducted by IDNS. The report concludes that all agreed upon radiological cleanup criteria were met. Three copies are enclosed for your use.

I hope you find your report useful. If you have any questions, please call me at (217) 782-1322.

Sincerely,

Richard Allen

Rich Allen, Manager
Office of Environmental Safety

RA:tlk

Enclosures

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Appendix B

Site Summary and Inspection Checklist

U.S. Department of Energy, Office of Legacy Management
Grand Junction, Colorado, Office

2004 SITE SUMMARY AND INSPECTION CHECKLIST
SITE A AND PLOT M SITE, PALOS FOREST PRESERVE, COOK COUNTY, IL

Status of Site Inspections

Date of This Revision:	March 7, 2004
Last Annual Inspection:	March 13, 2003
Inspectors	Kirkpatrick and Reed
Next Annual Inspection (Planned):	Week of March 9, 2004
Inspectors	Reed and Widdop

Background

- Site A and Plot M are located within the Palos Forest Preserve District of Cook County, Illinois. The Forest Preserve owns the land and manages it as a park for recreational use. Hiking and mountain bike trails cross both Site A and Plot M. The Red Gate picnic area is a green sward (open space).
- The site is the original location of Argonne National Laboratory (previously the University of Chicago Metallurgy Laboratory), later moved to a new site a few miles northwest. Fermi's CP-1 reactor was reassembled here as CP-2.
- Site A is the burial site of a buried concrete-filled reactor shell (CP-3) and the concrete shield from CP-2; Plot M is a burial ground for wastes generated by early reactor operations and studies. Waste materials at Plot M have never been fully characterized, but site operations are said to have included metabolic studies and fission product separation activities (the tank wastes at Hanford fall into the latter category but whether the SAM activities involved separating Pu from U fuel isn't provided in the 2000 monitoring report where this information was found).
- Monitoring shows that containment (an inverted concrete box) is generally effective; some tritium has been detected in shallow perched ground water, surface water adjacent to the Plot, and ground water in the dolomite aquifer. Strontium-90 has been detected in perched water wells adjacent to Plot M.
- DOE funds ANL to monitor ground and surface water. ANL maintains the monitor wells.
- In recent years, DOE has reduced the monitoring program to reflect observations and risk. This has included decommissioning of some of the unneeded wells (performed by ANL). The monitoring program will be further reduced to reflect risk and the LTS&MP will be revised in FY 2004.

No.	ITEM	ISSUE	ACTION
1	Sampling locations	2002 monitoring network: Perched water (glacial till). Site A: 15 wells: BH-41, 42, and 44-56. Plot M: 12 wells: 2-6, 8-11, 26, 28, and 35. Deeper ground water (dolomite). Dolomite wells: 14 wells: DH 1-5, 9-15, and 17-18. Picnic wells: 4 wells: 5158, 5159, 5160, and 5215 12 surface locations All wells and surface sampling locations were GPS'd in 1999.	Inspect at least a subset of wells. ANL visits the wells regularly and maintains them. ANL reports that 6 wells were decommissioned in FY2001
2	Site A	Site A is wooded and unfenced. Hardwood forest is rapidly filling what open space remains. There are no as-built features other than wells and an historic marker.	Drive (or walk) perimeter road; observe changes, if any.
3	Plot M	Open space. Consists of 1-ft-thick concrete cover covered in turn by 2-ft-thick soil and grass. As-built features are wells and corner monuments set in concrete. An historic marker (marble block) is at the center of the open space.	Observe changes, if any. Ruts observed in grass approx 12 in deep; in 2001 Widdop asked Norbert Golchert to ask Palos Forest Preserve to fill with gravel and soil. Ruts present in 2003. Marker vandalized previously, look for additional damage.

Medical & Emergency Service Information

ANL personnel will accompany DOE personnel on site. There are no telephones convenient to the areas that will be inspected. Carry a cell phone for access to 911.
Other emergency contact phone numbers are in the Project Safety Plan.

Directions to Site

Mile 0.00 Argonne Lab Main Gate (NE side of facility, 9700 South Cass Ave.)
Proceed south on Cass Ave. until it ends on Bluff Ave.
Turn left onto Bluff Ave.
Mile 2.0 Turn right on Hwy 83 (Kingery Ave.)
Mile 3.0 Across Bridge and then turn left onto Hwy 171 (Archer Ave.)
Mile 4.0 Turn right up entrance road to Site A (locked gate at turn off in 2001) (Red Gate Woods entrance is 200 yards further up Archer Ave on right)